

This lesson is part of a larger, comprehensive school garden guide called **Minnesota School Gardens: A Guide to Gardening and Plant Science** developed by Minnesota Agriculture in the Classroom in 2013. The entire guide is available at www.mda.state.mn.us/maitc.



Grade

Elementary 3-5

Materials/Preparation

- ☐ Handout A – Plant Dimensions Chart – one per student
- ☐ Handout B – Plan It, Map It – one per student
- ☐ Seed catalogs or Internet access to seed catalogs
- ☐ Rulers, yardsticks, measuring tapes
- ☐ Paper, graph paper or notebook (or purchase garden planning software to use computers)
- ☐ Writing instruments

optional

- ☐ Calculators

Fun Fact

Apple trees take four to five years to produce their first fruit.



Plan It, Map It

Minnesota K-12 Academic Standards

Math	3.3.2	Understand perimeter as a measurable attribute of real world and mathematical objects. Use various tools to measure distances.
Math	4.3.2	Understand angle and area as measurable attributes of real world and mathematical objects. Use various tools to measure angles and areas.
Math	5.2.3	Understand and interpret equations and inequalities involving variables and whole numbers, and use them to represent and solve real-world and mathematical problems.
Science	3.4.1.1 5.4.1.1	Living things are diverse with many different characteristics that enable them to grow, reproduce and survive.
Science	5.4.2.1	Natural systems have many parts that interact to maintain the living system.

Summary/Overview

Using the information provided, students use math skills to plan their garden.

Garden Connection

Students learn about plant varieties, row width, space between plants, and height.

Background Information

Living things compete with one another to survive and reproduce. Plants have differing characteristics unique to their species and variety. Even within species there are differences between varieties. Consider the number of different squashes, or the variety of tomato plants. Much of the information in this guide sets standard parameters that plants need. But this can vary. This activity gives students the opportunity to experience first-hand that math has a purpose with real-life applications, research various plant information, and make decisions about the garden they will plan and plant.

Objectives

- List plant-growing requirements to consider when planning a garden.
- Use simple multiplication to calculate garden rows and size.

Procedure

Interest Approach

Have students brainstorm their favorite vegetables. Create a list on the board.

Summary of Content and Teaching Strategies

Groundwork: Spacing Requirements

Have students select vegetable plants they could plant in the garden. Make a list of those plants. Students may refer to the list of favorite vegetables from the Interest Approach above.

Using hard copy seed catalogs or online seed suppliers, ask students to identify the number of varieties of one of these vegetables. Students can work in small groups to find the information on their chosen or assigned vegetable. Provide students with copies of Handout A. They list the names of the varieties available on Handout A. Burpee Seeds online is a good resource for finding this information.

NOTE: For plants with more than 10 varieties, have students select a specific type of that vegetable (i.e. tomatoes: select full-sized, slicing tomatoes or heirloom; squash: select winter squash or summer squash; peppers: select sweet bell peppers or hot peppers).

Ask students to identify each variety's growing requirements and note them in the chart provided. Have them select the variety they think is best to plant in the school garden and estimate the number of plants they would like to have.

Next have students calculate the number of square feet their garden will require to grow the number of vegetables they have selected. Students then create a rough-draft map of their garden drawn to approximate scale. The teacher should set the specific scale for the class and determine if the garden will be planted using rows or square foot gardening.

Groups take turns sharing the information on their specific vegetable with the rest of the class.

Exploration

Designing the School Garden

Give students the actual school garden dimensions. Share what garden space will be available for their class to use.

Have students determine what and how many of each plant they will incorporate into the garden. Decisions to be made:

1. Will each student have his or her own plant or plants (number)?
2. Will each student have the same type of plant?
3. If so, what will it be? If not, how many total types of vegetables will be grown?
4. Will more than one variety of each vegetable be grown?



As a group, plan the school garden. Consider plant height in relation to the sun to prevent tall plants from shading short plants. Also plan room for humans to weed, water, and harvest the garden.

Instruct students to make a scale drawing of the garden plot. For younger students, plant needs can be depicted graphically by making a paper pattern of the space needed by each plant. Use these patterns to map out the garden in scale size.

Review/Summary

Have students answer the following questions in small groups:

1. Name three vegetables that can be grown in a garden.
2. Explain why it is important to leave room between plants.
3. Describe why plant height needs to be considered when planning a garden.

Modifications/Extensions

- Have students create algebraic equations for planning the garden.
- Have students create gardens that incorporate circles, triangles, rectangles, octagons, and create a garden diagram drawn to scale that provides adequate plant space and human working space.
- Have students create three-dimensional gardens that use fencing, wire cages, climbing poles, etc. to make use of vertical as well as horizontal space.



*"Children are born naturalists.
They explore the world with
all of their senses, experiment
in the environment, and
communicate their discoveries
to those around them."*

The Audubon Nature Preschool

Sources/Credits

The above lesson is provided courtesy of Florida Agriculture in the Classroom, Inc. from its *Gardening for Grades* school garden curriculum.

Name _____



Plant Dimensions Chart

Vegetable Selected			
Variety	Row Width	Space Between Plants	Height

Name _____



Plan It, Map It

1. Name three plants you would like to grow.

2. Select one of those plants and list it below.

Does this plant have any special needs?

3. How much distance should there be between this plant and the next plant in the same row?

4. If this plant were planted in several rows, how far apart should each of these rows be from the next row?

5. How tall does this plant grow?

Grade

Elementary K-3

Materials/Preparation

- ☐ Handout A – Plant Illustrations – one per student
- ☐ Crayons or markers
- ☐ Scissors
- ☐ Staples, glue sticks or tape
- ☐ Samples of fruits and vegetables that represent different plant parts. (When possible, save one example of each of the following. Wash and cut the rest into bite-sized samples for tasting: fruit or flower – apples, oranges, grapes, kiwi, strawberries, broccoli, cauliflower; seed or flower – peas in a pod, sunflower or pumpkin seed snacks, popcorn; leaf – lettuce; stem – celery; root – carrot, radishes.)
- ☐ Tray for samples
- ☐ Vegetable dip
- ☐ Tub of cream cheese mixed with equal amount of brown sugar for fruit dip
- ☐ Spoons for dips
- ☐ Small paper plates – one per student
- ☐ Napkins – one per student



Plant Parts Become Me

Minnesota K-12 Academic Standards

Science	0.4.1.1 1.4.1.1 2.4.1.1	Living things are diverse with many different observable characteristics.
Science	3.4.1.1 5.4.1.1	Living things are diverse with many different characteristics that enable them to grow, reproduce and survive.

Summary/Overview

Students begin by reviewing the main parts of plants through a role-play activity. They design their own plants and compare the variety of their creations to those of their classmates. Students identify and taste fruits and vegetables that come from different plant parts.

Garden Connection

Roots, stems, leaves, flowers make up the foods we harvest from gardens.

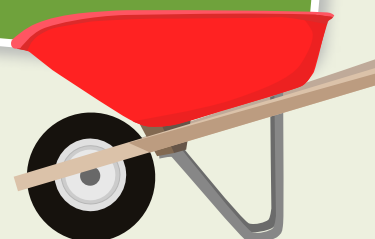
Background Information

Plants have four basic parts: roots, stems, leaves, and flowers. Roots anchor and support plants as well as absorb nutrients and water. Roots also store excess food produced by the plant. Stems support leaves and flowers. They also act as a transportation system moving water and nutrients up from the roots and taking excess food produced by the plant down to the roots. The main job of leaves is to create food and energy through the process of photosynthesis. Finally, flowers provide plants a way to reproduce. The brightly colored petals attract insects, which aid in pollination. Pollination leads to fertilized eggs that create new seeds.

While each plant part is crucial to the growth and development of the plant, humans also benefit from these parts. The fruits and vegetables we eat come from the four main parts of a plant as well as from the seeds. Edible roots include carrots and radishes. Asparagus, celery, and rhubarb are stems. Lettuce is an edible leaf. Most of the flowers we eat have turned into fruits. Fruits are the fleshy produce containing one or more seeds. Apples, oranges, grapes, kiwi, strawberries, broccoli, and cauliflower are all examples of flowers or flowers that have grown into fruit. Edible seeds include peas in a pod, sunflower or pumpkin seeds, and popcorn.

Fun Fact

Carrots are members of the parsley family, characterized by the feathery green leaves. Other members include parsnips, fennel, dill, and celery.



Objectives

- Identify the four parts of plants and their functions.
- Make connections between plants and personal food choices.

Procedure

Interest Approach

Guide students in a role-play activity where they pretend to be a plant. Start by pretending that it is spring and you are seeds that have been planted in the ground. Curl up on the floor or “ground” like a seed in our garden. You are underground. The soil or ground is all around you. Spring rains come down and soften the seed coat so that your roots start to grow into the soil.

Ask students, “What part of your body can you use to become roots?”

Feet and legs are the roots growing out of the seed and pushing down into the soil. Roots are the first plant part to grow out of seeds. Wiggle your toes as your roots start growing out of the seed.

Ask students, “What part of your body is the stem?”

Your body is the stem. Wiggle your bottom, shoulders, and elbows. Pop up your head and start growing tall. Stand up tall and straight so that your stem is growing above the ground. (Above ground is the height of desks or tables.)

Ask students, “What parts of your body could be the leaves and branches?”

Your arms could be branches and your hands and fingers could be leaves. Put your arms out away from your body and wiggle your hands and fingers as if they were leaves fluttering in the breeze. Reach toward the sky to catch the sun’s rays.

Stand up straight with your head held high and a big smile on your face because your head is a beautiful flower on top of a sturdy stem. Move it back and forth like it is enjoying the sunshine and the breeze.

Summary of Content and Teaching Strategies

Groundwork: Designing Plants

Distribute Handout A. Have students look at the pictures on the activity sheet and identify the four parts of a plant. Every picture in the first column is a root. Every picture in the second column shows a stem and leaves. Every picture in the third column is a flower. Explain that flowers develop into fruit that contains seeds.

Provide crayons or markers for students to color pictures of the plant parts on Handout A. Students can design their own plants by carefully cutting out the boxes with the pictures. Mix them up and design a favorite combination to make plants, each with a top, middle, and bottom in the correct order.

After the students have colored, cut, and lined up their plants, they attach the parts in any of the following ways.

Staple or glue them on paint stir sticks so they can carry them around like stick puppets and pretend to plant them in a flowerpot in the room.

- Glue them on colorful construction paper to hang around the room.
- Tape them together in a strip and hang them around the room.

Have students name their new flowers and tell the rest of the class about them. Discuss similarities and differences.

- How many people put the same combinations of flowers, leaves, and roots together?
- How many different combinations do we have?
- How many are exactly the same?

Exploration

Edible Parts of Plants

Review the four parts of plants. Make four columns on the board with these headings:

- flowers
- leaves
- stems
- roots

If desired, flowers can be further subdivided into fruits and seeds.

Before the following activity, wash and cut fruit and vegetable plant part samples and put them on a large tray. Prepare the dips for spooning out onto the students' plates.

Ask students what fruits and vegetables they have eaten yesterday and today. Have them list what they ate under columns on the board labeled roots, stems, leaves, and flowers. Explain that fruits and vegetables are important to our health because they contain vitamins and minerals that help keep us healthy. They also contain fiber to help clean out our bodies. Eating a variety of vegetables and fruits of different colors is a healthy eating habit.

Have the students wash their hands in preparation to try some vegetables and fruits. Show them actual samples of roots – an entire carrot; stems – a celery stalk but remind them it is really a leaf stem; leaves – a lettuce leaf; and flowers – an entire apple or orange. Have them guess what they are and what part of a plant they come from. Give each student a small paper plate and a napkin. Show the tray of fruits and vegetables and encourage the students to try at least two to three different fruits and vegetables. Offer ranch dressing and cream cheese mixed with brown sugar to use as dips. The dips may encourage them to try new vegetables and fruits. If choosing is difficult for your students, prepare sample plates for them. Optional: Challenge students to try one root, one stem, one leaf, and one flower.

Discuss and describe the differences in flavor, texture, and color between the root, stem, leaf, and flower.



Sources/Credits

Adapted from Growing in the Garden Elementary Curriculum that Grows with the Child written by the Iowa 4-H Development Program and revised in June 2012. The curriculum can be purchased from the Iowa State Extension Office <http://www.extension.iastate.edu/4h/page/curricula-info-ordering>

Review/Summary

Divide the class into four groups and assign each group one of the foods listed below. Some foods may be assigned to more than one group; add your own food ideas to the list. Students discuss the vegetables or fruits that are in each food and the plant part they come from. Have groups report back to the class. You may want to write the ingredients on the board or provide students with a labeled colored picture of their food.

- **Pizza** – onions (leaves); tomatoes, peppers, olives (fruits); crust (wheat seeds)
- **Hamburger** – onion, lettuce (leaves); tomato, catsup (fruit); mustard (seeds); bun (wheat seeds, sesame seeds)
- **Vegetable soup** – onions, celery (leaves); potato (stem); tomatoes, pepper, peas, beans, okra (fruit); carrots (roots)
- **Spaghetti and sauce** – tomatoes, peppers (fruit); onions (leaves); pasta (wheat seeds)

Modifications/Extensions

Get “Dirt Made My Lunch or Singing in Our Garden” CD by the Banana Slug String Band (bananaslugstringband.com). After playing the song, ask students to identify the six parts of the plant listed in the song. Ask them what each part is doing in the song.

Read *Stone Soup* by Marcia Brown. Make cards for each vegetable mentioned in the book and distribute to students. As you read, have students bring their cards to the front when each vegetable is read. They can sort the vegetables by plant parts at the front of the room.

Name _____



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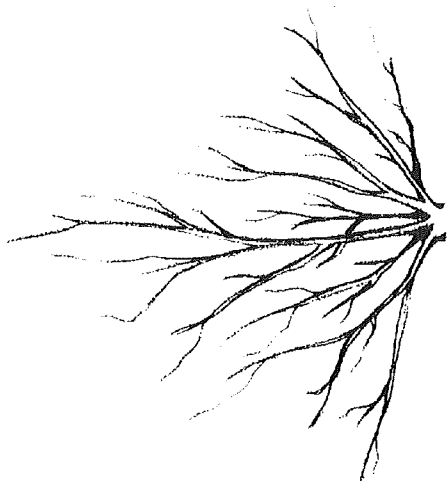
Roots, Stems, Leaves, and Flowers

ACTIVITY SHEET
PLANT PARTS BECOME ME!

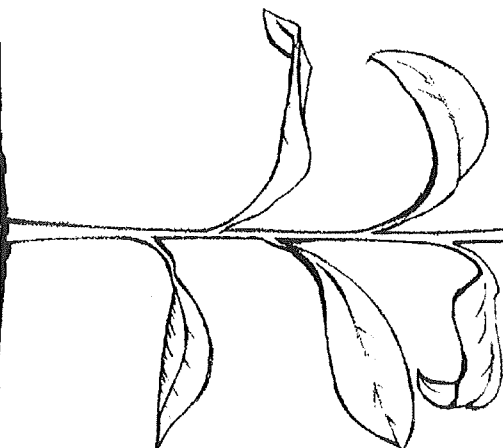
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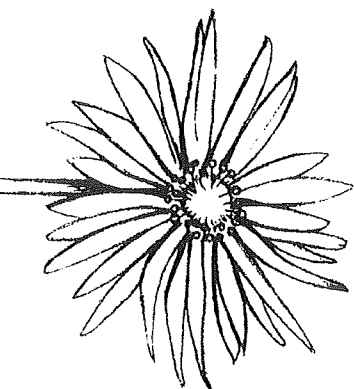
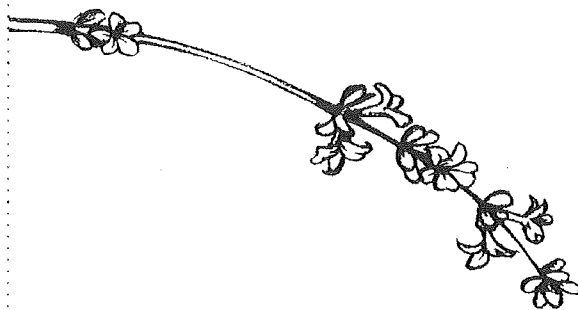
Roots



Stems and Leaves



Flowers



Grade

Middle School

Materials/Preparation

- ☐ Teacher Material A – Parts of a Plant – one per teacher
- ☐ Teacher Material B – Edible Plant Parts – one per teacher
- ☐ Handout A – Salad Investigation Report - one per student
- ☐ Assessment A – Salad Investigation – one per student
- ☐ Paring knife
- ☐ Salad ingredients: Enough to make each student one small salad each with seven of the following: carrots, lettuce, tomatoes, sunflower seeds, celery, broccoli, cucumbers, mandarin oranges
- ☐ Plates, napkins, and forks – one set per student
- ☐ Variety of salad dressings
- ☐ Writing utensils

Before class begins, prepare enough miniature salads for each student in the class to have one. Choose seven plant foods from the Materials list or add your own. Salads should include samples of at least one of each of the six basic plant parts. (Suggestion: have salads prepared and set at each student's individual seat with a fork and napkin). Display Teacher Material A on a large board or suitable wall space.

Salad Investigation

Minnesota K-12 Academic Standards

Science	7.4.1.1	Tissues, organs and organ systems are composed of cells and function to serve the needs of all cells for food, air and waste removal.
Health	6.6.1	The student will apply strategies and skills needed to attain personal health goals.

Summary/Overview

Students learn about edible plant parts and the difference between fruits and vegetables while eating a salad.

Garden Connection

Students identify the parts of plants used to make a salad.

Background Information

Plants are the most important source of food in the world (both for humans and animals). All the fruits, vegetables, and starches we enjoy each day come from the six distinct parts of plants: roots, stems, leaves, flowers, seeds, and fruits. Edible plant parts are classified as either vegetables or fruits. *Vegetables* are any edible part of the plant that is not the fruit. This includes foods that are leaves, roots, stems, flowers, and seeds. Technically, *fruits* that we consume (apples and oranges, for example) are the fruiting body of the plant. Believe it or not, ketchup is a fruit product because it is derived from the fruit of a tomato plant.

Objectives

- Cite five examples of edible plant parts.
- Explain the difference between fruits and vegetables.

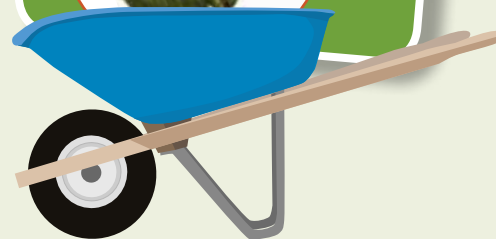
Procedure

Interest Approach

Tell students not to touch the salad, napkin, or fork on their desk. Have them wash their hands. Or you may wish to provide hand-sanitizing gel. Provide students with copies of Handout A. Invite them to be detectives investigating their salad and name the seven different food components on the Salad

Fun Fact

An apple is in the pome family – a fruit whose seeds are embedded in the core of the fruit. Another surprising member of this family is the rose.



Investigation Report. Point out the “salad component” section on the worksheet. Provide students with three minutes to complete this one column. Verbally review each component of the salad.

Summary of Content and Teaching Strategies

Review the parts of the plant. Display Teacher Material A and have students point out the plant parts. Plants are the most important source of food in the world (both for humans and animals). The fruits, vegetables, and starches we enjoy each day come from different parts of the plants. These foods are all one of the six main plant parts: roots, stems, leaves, flowers, seeds, and fruits.

Discuss the difference between fruits and vegetables. Decide whether each of the salad foods is a fruit or vegetable, and what part of the plant it is. Ask students to do this activity in pencil so they can go through each one and correct any answers that need to be rethought. Invite them to add other foods that come from this same part of the plant.

Discuss commonly misnamed fruits and vegetables. There is a simple way to remember the difference. Vegetables are any edible part of the plant that is not the fruit. This includes foods that are leaves, roots, stems, flowers, and seeds. Discuss information on **Teacher Material B**. Point out these plant parts on **Teacher Material A**. Discuss the vegetables and fruits students listed on their Salad Investigation Reports. The reports should now be completed. Provide salad dressing and invite students to eat their salad.



Review/Summary

Have students answer the following questions in small groups:

1. What part of the plant is lettuce?
2. Is a cucumber a fruit or vegetable? (Fruit; seeds are inside)
3. Name an example of a vegetable. (Lettuce, carrots, turnips, lima beans, etc.)
4. Is ketchup a fruit or vegetable product? (Fruit because it comes from tomatoes, which are the fruit of the tomato plant.)

Modifications/Extensions

Have students do a fanciful Complete Salad Plant activity. Students draw single plants that could be a complete salad; their parts are made of the foods discussed in the lesson (carrots, lettuce, tomatoes, sunflower seeds, celery, broccoli, cucumbers, mandarin oranges). Students label each plant part with the name of the food and which of the six basic plants is represented (for example: lettuce leaves, carrot roots). Have students share their drawings with classmates. Post these in the classroom as a fun reminder of the origins of their salad.

Challenge students to use the knowledge they gained from this lesson to write three healthy eating goals for themselves. The goals should relate to eating a variety of healthy foods and include foods from each plant part.



Sources/Credits

Adapted from: National FFA Organization Middle School Food and Agricultural Literacy Curriculum, sponsored by the National Pork Board as a special project of the National FFA Foundation. Visit www.ffa.org/documents/learn/MS.PS.1.3.pdf to access the full length version of this lesson.

Parts of a Plant

Leaves Functions:

1. Site of photosynthesis
2. Absorbs sunlight to produce energy
3. Site of the majority of transpiration

Flower Functions:

1. Site of reproduction
2. Contain male and/or female parts
3. Can be bright and fragrant to attract pollinators

Stems Functions:

1. Channel of water, nutrient, and sugar transportation throughout the plant
2. Supports buds and leaves

Fruit Functions:

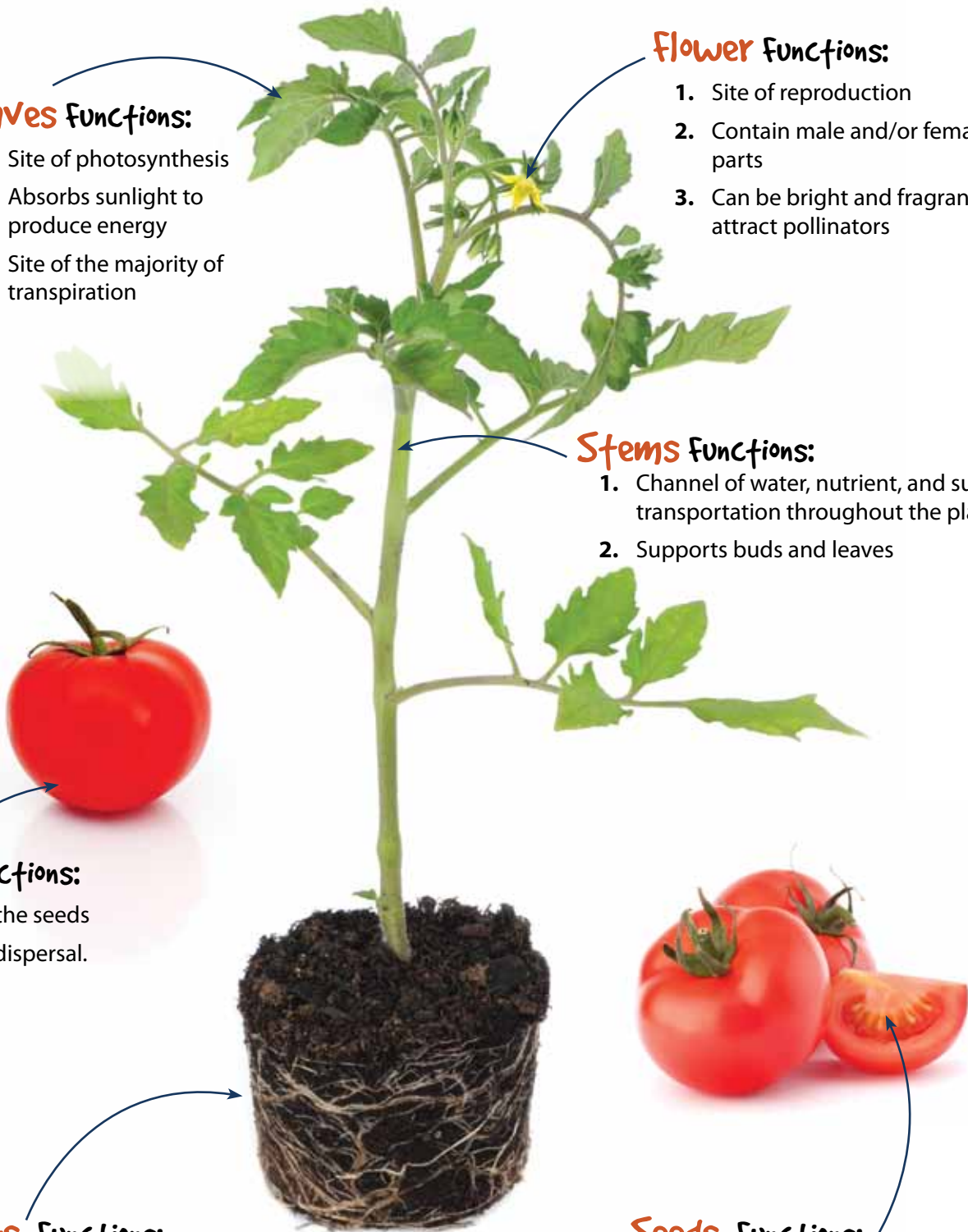
1. Protect the seeds
2. Help in dispersal. How?

Roots Functions:

1. Absorb water and minerals from the soil
2. Anchor plant to ground
3. Support stem structure

Seeds Functions:

1. Contain the embryo which will become new plants



Edible Plant Parts

A. Plants are the most important source of food in the world (both for humans and animals). The fruits, vegetables, and starches we enjoy each day come from different parts of the plants. All these foods are one of the six main plant parts: roots, stems, leaves, flowers, seeds, and fruits. Edible plant parts are classified as either vegetables or fruits.

B. Vegetables: Vegetables are any edible part of the plant that is not the fruit. This includes foods that are leaves, roots, stems, flowers, and seeds.

1. **Roots:** Roots collect water and minerals from the soil. Roots are also used for energy and food storage for some plants. Examples of edible roots include carrots, beets, turnips, and rutabaga.
2. **Stems:** Stems transport water and minerals from the roots to the rest of the plant and transport the energy created by photosynthesis from the roots to the rest of the plant. Commonly eaten stem parts include celery, onions, and potatoes. Potatoes are actually modified stems that plants use to store energy, which is why they are such a great source of energy.
3. **Leaves:** Leaves are the primary site of photosynthesis in plants. They are also the site of transpiration. Leaves are a great source of many vitamins needed for healthy humans and animals. Commonly consumed leaf foods include lettuce, kale, spinach, cabbage, collards, and mustard greens.

4. **Flowers:** Flowers are the reproductive structure in plants and can contain male (stamen) and/or female (pistil) structures. Flowers are usually the flashiest part of the plant in order to attract pollinators. Many flowers are common foods for humans including broccoli and cauliflower.
5. **Seeds:** Seeds are the mature ovules that are originally found in the female part of the flower and are usually housed in a type of fruit or cone. Seeds contain the embryo, which will germinate and become a new plant. Common edible seeds include lima beans, peas, sunflower seeds, green beans, and pinto beans.

C. Fruits: Technically, fruits that we consume (apples and oranges, for example) are the fruiting body of the plant..

Fruits are formed from the fertilized ovule (seeds) and the ovary walls of the female part of the flower. The fruit protects the seed and assists in the dispersal of seeds (by attracting animals that may consume the fruit and disperse the seed). Edible fruits include apples, oranges, and strawberries. Although they are often called vegetables, tomatoes and cucumbers are also the fruit of the plant.

Vocabulary Words

Ovules: small eggs found in the female part of the flower

Photosynthesis: the process by which plants use energy from the sun, carbon dioxide, and water to make food

Pollinator: an agent that transfers flower pollen from the male anthers to the female stigma

Transpiration: water evaporation from leaves

Name _____



Salad Investigation Report

As we explore the components of our salads, fill in the following chart. **First**, list the seven components. **Second**, determine whether the food is a vegetable or fruit and write a V or F in the box. **Third**, name what part of the plant it is (root, stem, leaves, flowers, fruit, or seeds). Finally, list 3-4 examples of other plant foods that are from the same part of the plant as the component.

Salad component	Fruit or Vegetable?	Part of Plant	other Foods from this Plant Part



Salad Investigation

Determine whether each food is a fruit or vegetable. In the third column, name the part of the plant the food is. Use the list of basic plant parts below.

Plant Parts					
Root	Stem	Leaves	Flower	Seed	Fruit

Name of Food	Fruit or Vegetable	Plant Part
Turnip Greens	1.	2.
Carrots	3.	4.
Lima Beans	5.	6.
Tomato	7.	8.
Celery	9.	10.
Broccoli	11.	12.

Grade

Middle School

Materials/Preparation

- ☐ Teacher Material A – Mind Map Example – one per teacher
- ☐ Assessment A – Importance of Plants – one per student
- ☐ Computer
- ☐ Poster paper
- ☐ Notebook paper
- ☐ Magazines
- ☐ Scissors
- ☐ Glue
- ☐ Writing Utensils
- ☐ Markers
- ☐ Food for Thought Desk Map*

*The Food for Thought Desk Map is available online at www.mda.state.mn.us/Global/MDADocs/kids/food4thought/deskmap11x17.aspx. Printed maps can be ordered from Minnesota Agriculture in the Classroom.

Fun Fact

Carrots have a higher natural sugar content than all other vegetables with the exception of beets.



Importance of Plants

Minnesota K-12 Academic Standards

Science	7.4.3.2	Individual organisms with certain traits in particular environments are more likely than others to survive and have offspring.
Social Studies	5.3.1.3	Places have physical characteristics (such as climate, topography and vegetation) and human characteristics (such as culture, population, political and economic systems).
Social Studies	7.3.1.1 8.3.1.1	People use geographic representations and geospatial technologies to acquire, process and report information within a spatial context.

Summary/Overview

Students learn about the importance of plants and create a mind map to display the ways in which plants influence their lives. Next they use a thematic map to help understand why crops grow in specific areas of the state.

Garden Connection

Students explore some factors that influence plant growth.

Background Information

Plants impact our daily lives. Students may not realize how many products they use contain plants. This lesson opens their eyes to the importance of plants. In order to effectively grow the plants we use so often, it is helpful to know what influences plant growth. Landforms, annual precipitation, annual frost-free days, and native vegetation all play a role in where farmers and gardeners choose to grow certain crops in Minnesota. Students review maps of these factors and compare them to maps showing growing areas of four major crops.



Objectives

- List five ways humans use plants.
- Explain factors that influence crop production.
- Identify important crops grown in Minnesota.
- Analyze why crops are grown in specific areas of Minnesota.

Procedure

Interest Approach

As students enter the room, have them write one way they have used plants during the day on the board. After everyone has shared, review the answers as a class. Ask how the answers might be categorized. As a class, develop categories. Examples: food, fiber, building materials, oxygen, medicine, beauty, and economic value. Help students think of any areas that might be missing.

Summary of Content and Teaching Strategies

Plant Uses

On notebook paper, instruct students to create the outline of a mind map for the importance of plants. See Teacher Material A for a sample outline. Use categories developed by the class or example categories.



Divide the class into groups assigning each group a plant use category. Each group makes a poster with a list of plants and plant materials that belong in their category. Next groups should add pictures or magazine clippings illustrating items found in their category. Students may need to research their topic using a computer. Have each group share their findings with the class. Students note the findings on their mind maps.

Sources/Credits

This lesson was developed for the Minnesota Garden Guide.

Factors Influencing Growth

Understanding factors that influence plant growth is critical for a successful harvest. Ask students to brainstorm a list of things they think affect plant growth. Be sure they include landforms, annual precipitation, annual frost-free days, and native vegetation on their lists. Discuss how different plants require different kinds of growing conditions to thrive.

Utilize Minnesota Agriculture in the Classroom's (MAITC) Food for Thought maps and curriculum to investigate Minnesota's plant growth factors.

Plants in Minnesota

Next ask students to name and list important agricultural crops grown in Minnesota. For each crop, ask students to develop a hypothesis as to why these crops grow in each particular area of Minnesota.

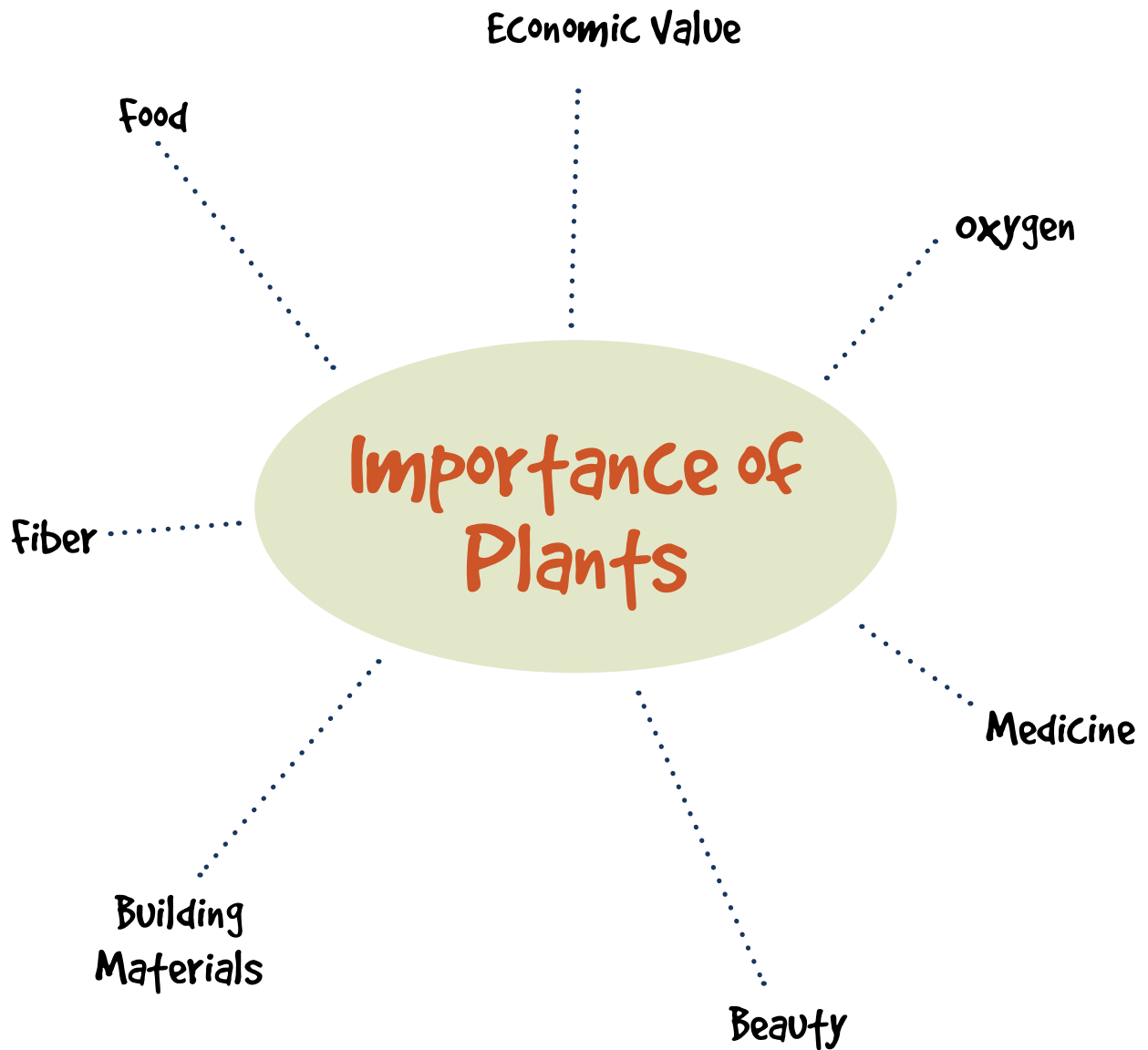
Again consult MAITC's Food for Thought maps and curriculum to discover Minnesota plant growth locations and conditions.

Review/Summary

Ask students to name three uses of plants they learned about during the lesson. Discuss the hypotheses they developed while looking at the maps of Minnesota.

Modifications/Extensions

Utilize lessons from the Food for Thought Mapping Curriculum *Connecting Minnesota Geography, Agriculture and Communities* available from Minnesota Agriculture in the Classroom. www.mda.state.mn.us/kids/food4thought.aspx



Name _____



Importance of Plants

1. List five ways humans use plants.

2. Name two factors that influence crop production.

3. Identify two important crops grown in Minnesota.

4. Explain why some crops are grown in northern Minnesota and others are grown in southern Minnesota.

Grade

High School

Materials/Preparation

- ☐ Teacher Material A – Plants in Our World – one per teacher
- ☐ Handout A – Surrounded by Plants – one per student
- ☐ Assessment A – Surrounded by Plants – one per student
- ☐ Computers with Internet access and ability to print
- ☐ Colored pencils
- ☐ Notebooks
- ☐ Map of U.S. from the 50states.com website
- ☐ USDA Agricultural Census Data from USDA website <http://www.agcensus.usda.gov>

Fun Fact

It takes about 36 apples to create one gallon of apple cider.



Surrounded By Plants

Minnesota K-12 Academic Standards

Science	9.4.2.1	The interrelationship and interdependence of organisms generate dynamic biological communities in ecosystems.
Science	9.4.4.1	Human activity has consequences on living organisms and ecosystems.
Social Studies	9.3.1.1	People use geographic representations and geospatial technologies to acquire, process and report information within a spatial context.

Summary/Overview

In an effort to connect students with the key idea of plant importance for human life, Surrounded by Plants begins by asking students to survey their home and neighborhood for plant products they encounter in daily life.

Garden Connection

Plants harvest energy from the sun and provide us with many usable products.

Background Information

Plants are vital to all life on Earth. They mean survival. Plants are the base of food for all humans and animals. They can harvest energy from the sun and exchange gas. (Plants use carbon dioxide from the air and convert it into oxygen.) Plants use the energy from sunlight to convert raw materials from the Earth into carbohydrates, fats, and oils. Humans depend on plant materials for food, feed for livestock, fiber, fuel, medicine, aesthetic value, and much more.



Plants are affected by environmental factors, including frost-free periods or growing season, mean average temperature or growing degree days, and rainfall. These factors create unique growing conditions across the United States and throughout the world.

Objectives

- Identify why plants are critical for all life on Earth.
- List plant products found in your everyday world.
- Explain why certain plants are grown in certain regions of the United States.
- Compare and contrast the growing conditions in Minnesota to other areas of the country.

Procedure

Interest Approach

Ask student to think about the many times a day they touch or eat things that come from plant materials. Our world consists of an unimaginable number of products originating with plants. Students are likely touching several as they sit in a chair and take notes in their notebooks. Plants are a major part of daily life in several forms. As a class, make a list of plant products found in the classroom.

Summary of Content and Teaching Strategies

Present and discuss Teacher Material A. Have students brainstorm examples for each of the ways humans use plant material.

Distribute a copy of Handout A to each student. Review the handout and answer any questions. Have students complete the triangle in Figure 1. Part 2 of the activity is for students to research the common growing regions for one crop from each category in Figure 1. The directions instruct students to print off a United States map from the 50states.com website at <http://www.50states.com/maps/print/usamap.htm>. Using this map, students shade growth regions using colored pencils for one crop from each use category. Use a different color for each crop and label the colors in a map legend. Students must incorporate the TODALS (title, orientation, date, author, legend and scale) map basics into the map they create.

For forestry products, the USDA Forest Service database is provided: http://www.srs.fs.usda.gov/pubs/misc/misc_reston.pdf.

Students will need to research medicinal crops separately. The following are common medicinal crops to consider providing to students who need assistance in this category:

- aloe
- Echinacea
- Saint John's Wort
- aspirin
- ginkgo
- castor bean
- hemp

Once Part 2 is completed, students access hardiness zone and precipitation websites to determine the climate correlations to the production regions shaded on their maps. This activity provides an understanding of why certain crops are grown in certain regions due to their dependence upon climate conditions. Find information on hardiness zones in the Teacher Information for Chapter 2 on page 53.

Review/Summary

Have students share their completed maps with the class and explain two things they learned during the activity.

Modifications/Extensions

Get a large wall chart of the United States and have each student add different crops to it in order to summarize crop-growing regions of the United States. Next have students research the social, economic, and ecological risks and benefits of changing a natural ecosystem as a result of human activity. Ask them how these changes might influence crop-growing regions in the future.

Students have researched environmental factors that affect where plants grow. Take this idea a step further and investigate how carrying capacity influences the population of particular plants. After further research, ask students to describe factors that affect the carrying capacity of an ecosystem and relate these to population growth.



Sources/Credits

Adapted from: *Curriculum for Agricultural Science Education (2012) Principles of Agricultural Science – Plant*. [Curriculum materials for secondary agricultural education instruction.] Lexington, KY.

Parker, R. (2010). *Plant and soil science: Fundamentals and applications*. Clifton Park, NY: Delmar. An *Introduction to Plant Science* is found on pages 174-184 and additional information on climate data is found on pages 247-257.

Plants in our world

Plants are vital to all life on Earth for two reasons:

1. **Harvesting the Sun:** Plants use the energy from sunlight to convert raw materials from the Earth into carbohydrates, fats, and oils.
2. **Gas Exchange:** Plants use carbon dioxide from the air and convert it into oxygen. The process of food production and gas conversion is called photosynthesis.

Human Value

What are some ways humans use plant material?

1. Food
2. Feed for livestock
3. Fiber
4. Fuel
5. Medicine
6. Aesthetic value

Crop Regions

Certain crops grow in specific regions of Minnesota and the United States. Influencing environmental factors include:

1. Frost free periods (growing season)
2. Mean average temperature (growing degree days)
3. Rainfall

Name _____



Surrounded by Plants

Part 1. Survey Personal Plant Exposure

Survey your home and neighborhood to determine the plant products you are exposed to every day. Complete the lists for the categories of plant products in Figure 1.

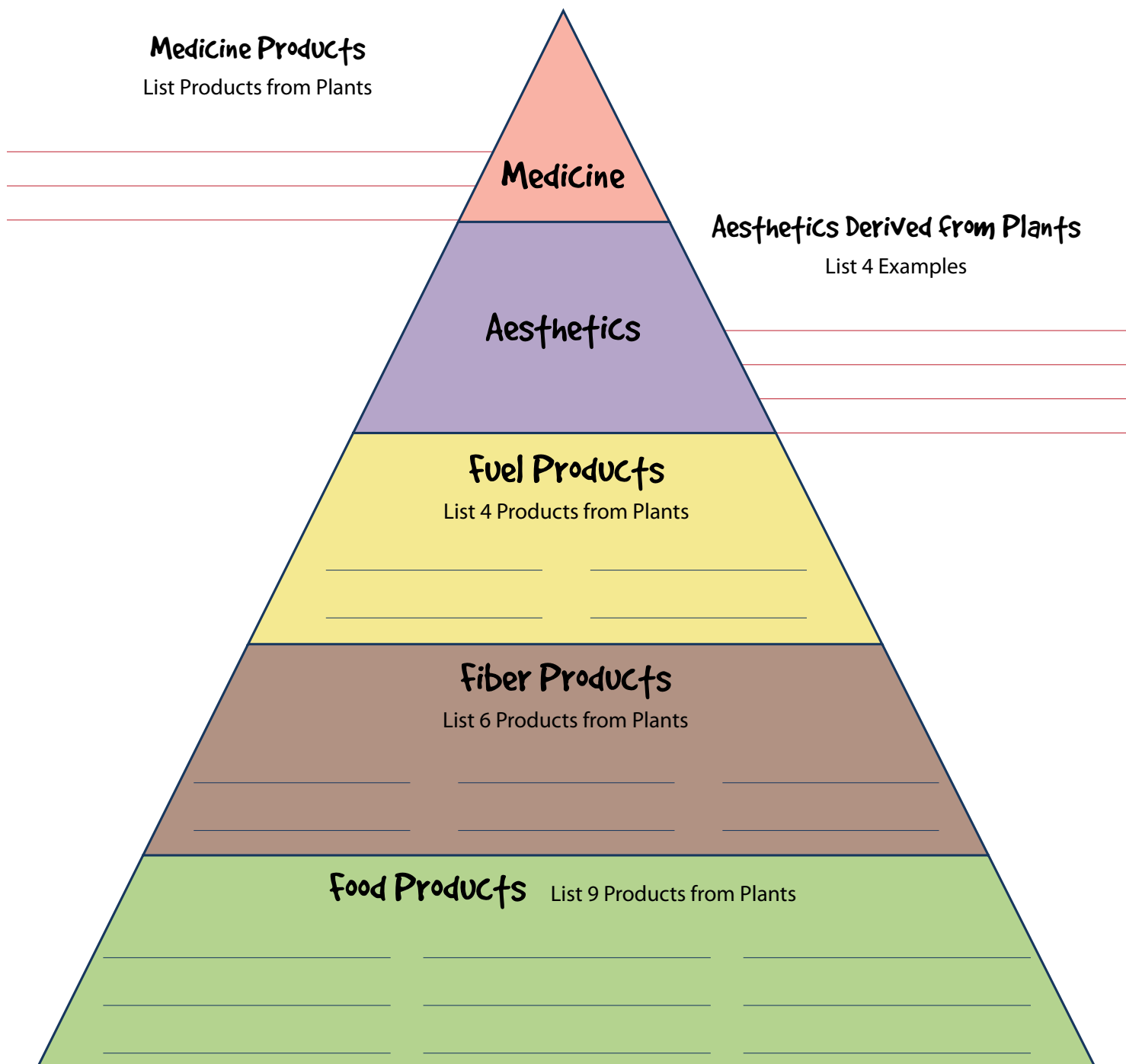


Figure 1. Crop Commodity Triangle

Part 2. Identify Crop Regions

1. Use the USDA Census website to locate the growing regions for ONE CROP from EACH CATEGORY listed in Figure 1.
2. Print off the map of the United States from the 50states.com website at <http://www.50states.com/maps/print/usamap.htm> and use it as the template.
3. Shade in the growing region of each crop using a specific color of pencil to indicate each crop. Include a key on the map to identify which color represents each crop.

For crop growing region, view the USDA 2007 Agriculture Census data:

http://www.nass.usda.gov/research/2007mapgallery/album/Crops_and_Plants/Field_Crops_Harvested/index.html

For information related to forestry products, use the following URL:

http://www.srs.fs.usda.gov/pubs/misc/misc_reston.pdf

Part 3. Identify Growing Conditions

Once your map of crop growing regions is complete, use the following websites to investigate what environmental influences, such as temperature and rainfall, affect plant production.

For plant hardiness zones, view the following website:

<http://www.usna.usda.gov/Hardzone/ushzmap.html>

For rainfall data related to crop regions, see the NRCS website:

<http://www.wcc.nrcs.usda.gov/climate/prism.html>

Conclusion

1. What environmental factors have the greatest effect on determining regions for crop production?

2. What are the predominant crops grown in Minnesota?

3. Explain how growing conditions in Minnesota compare to the southwestern part of the United States.

4. Why do you suspect a large number of cattle and hogs are raised in the Midwest United States?

5. List two plant products that you feel do not fit into any of the categories identified on the pyramid.

Name _____



Surrounded by Plants

1. Explain how plants “harvest” energy from the sun.

2. Name two ways humans use plants.

3. List two environmental factors influencing plants.

4. How do the growing conditions in Minnesota compare to those in other parts of the country?

Grade

High School

Materials/Preparation

- ☐ Handout A – Garden Goals – one per student
- ☐ Handout B – Action Plan – one per student
- ☐ Assessment A – Planning a Garden – one per student
- ☐ Writing utensils
- ☐ Computers (optional)
- ☐ Refer to Chapter One Teacher Information as needed on page 13.

Fun Fact

The World's Longest Carrot, recorded in 2007, was 19 feet 1 7/8 inches (5.839 meters) long.



Garden Goals

Minnesota K-12 Academic Standards

Language Arts	9.9.1.1b	Work with peers to set rules for collegial discussions and decision-making (e.g., informal consensus, taking votes on key issues, presentation of alternate views), clear goals and deadlines, and individual roles as needed.
Language Arts	11.9.1.1b	Work with peers to promote civil, democratic discussions and decision-making, set clear goals and deadlines, and establish individual roles as needed.
Language Arts	9.9.4.4	While respecting intellectual property, present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task (e.g., persuasion, argumentation, debate).
Language Arts	11.9.4.4	While respecting intellectual property, present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks (e.g., persuasion, argumentation, debate).

Summary/Overview

Students take ownership in the school garden by creating goals and planning for success.

Garden Connection

A successful garden requires planning and goal setting.



Background Information

Whether it is a trip, a birthday party, or a garden, the planning stage takes time, can be a lot of fun, and is a necessary step in ensuring success. Dreaming of the many possibilities and selecting favorites can be very exciting. As you plan your school garden, be sure to include the students in as much of the process as possible. The more the students are involved in decisions, the more they feel ownership in the project.

Objectives

- List three goals your school has for the garden.
- Create a garden design.
- Explain why the class selected a specific garden design.
- Make a list of activities and projects related to the garden.

Procedure

Interest Approach

Discuss different types of school gardens. Review the examples of school gardens in Minnesota listed after the Introduction in this guide (pages 6-9). Encourage students to note the differences in size and scope. Start a discussion about what kinds of gardens might work at your school.

Summary of Content and Teaching Strategies

Provide students with a copy of Handout A. Students complete the worksheet as you discuss each area.

Goals

Discuss each of the four key areas and why they are important parts of a school garden: outdoor classroom, student involvement, healthy eating, and community connections. Ask students to write down a goal for each of the four key areas as described in the Chapter One Teacher Information on page 13. When finished, they share their goals with a partner. Next ask pairs to list their goals on the board. As a class, come to a consensus on which goals to adopt.

Design

With the adopted goals in mind, what is the best design for your school garden? Have students brainstorm a list of possible garden designs. Gardens range from growing a few plants indoors near a window to a large in-ground vegetable garden. Help students select a garden design with a size and scope appropriate to your school. If this is the first year your school has had a garden, start small. Your garden can expand over the next several years.

Activities/Projects

Create a list of activities to do in the garden and projects related to the growing of plants. Brainstorm what skills and information students will learn from growing their plants. Examples of activities to be done in the garden include planting, weeding, watering, and harvesting. A project related to growing plants is to research recipes using herbs grown in a classroom window. Or, if you will be growing vegetables in a

large quantity to sell, have students research different methods of selling produce including Community Supported Agriculture (CSA) or farmers' markets.

As a class, develop an action plan to accomplish the goals of the garden. What steps need to be completed in order to get your plants started, maintain plants over the growing period, and harvest the crop? Include timelines and assign a lead person for each task.



If your schedule allows, evaluate the garden at the end of the project. Discuss what students learned from the experience, what went well and what could be improved.

Review/Summary

Discuss the following questions as a class or ask students to journal their responses.

1. Why is it important to create a plan for the garden?
2. What part of the garden are you most excited about?

Modifications/Extensions

Provide students with graph paper to map out the school garden to scale. Be sure they take into account spacing between plants and rows and allow for walkways. Maps should include a legend as well as indicate the scale used.

Sources/Credits

This lesson was developed for the Minnesota Garden Guide.

Name _____



Garden Goals

Brainstorm

Adopted By Class

Garden goals	<p>outdoor classroom</p> <p>student involvement</p> <p>healthy eating</p> <p>community connections</p>	<p>outdoor classroom</p> <p>student involvement</p> <p>healthy eating</p> <p>community connections</p>
Garden design		

Brainstorm

Adopted By Class

Garden activities/projects		
Plants to grow in the garden		

Name _____



Action Plan

Task	Timeline	Lead Person	others Helping

Name _____



Garden Goals

Create a brochure or PowerPoint presentation highlighting the different aspects of the school garden to be shared with administration, teachers, school board members, parents, and community groups. Be sure to include all items listed in the grading rubric.

	Points Possible	Grade
Content		
Goals	10	
Design	10	
Activities/Projects	10	
Appearance		
Pictures	5	
Creative	5	
Well organized	5	
Use of class time	5	
Total	50	

Include a scanned copy of the garden design.

Selection of Crops and Garden Themes

Chapter 2

Teacher Information

Crop Selection in Minnesota

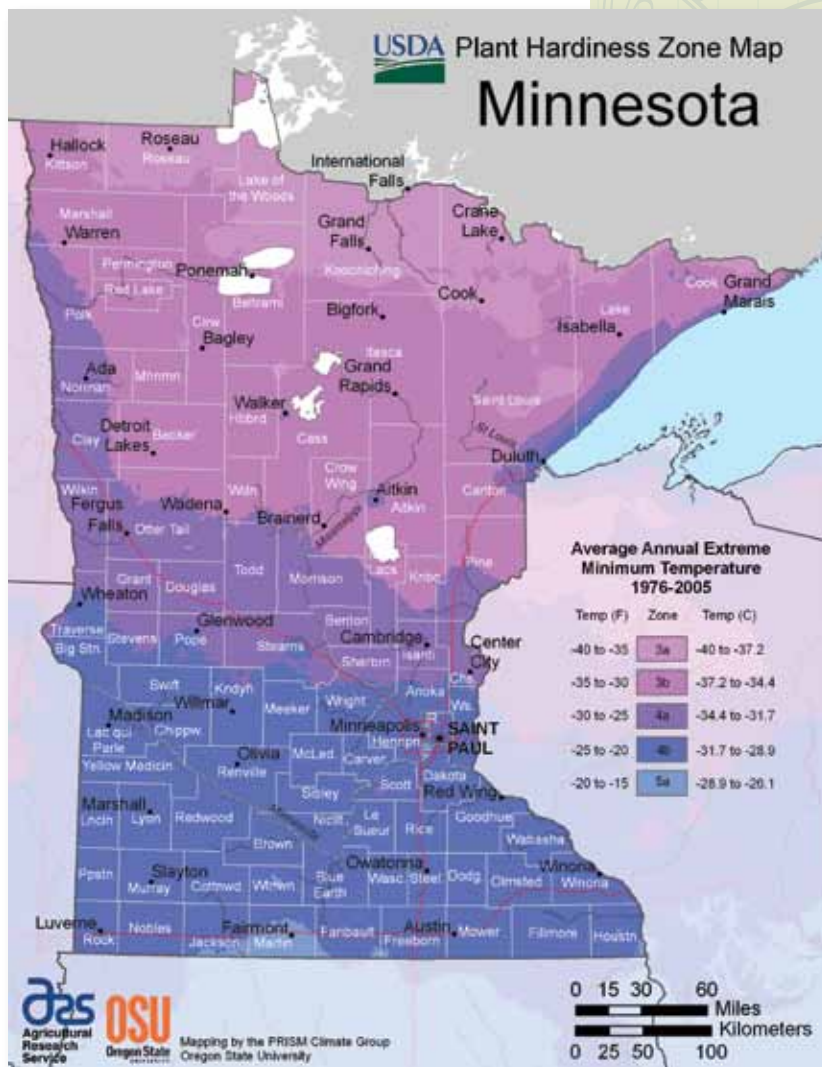
When choosing crops, there are several items to consider. Be sure to check the mature height of plants as well as the distance between plants and rows. If plants are too crowded they may not grow to maturity and produce quality fruit or vegetables. Next, determine if the plant is a warm or cool season crop. It is also important to note how and when to start plants. Some need to be started indoors and later transplanted while others can be seeded directly into the garden. Harvest dates are also vital to note, as you need to be prepared to remove produce from the garden. Finally, be sure to find out if the crop can grow in Minnesota climate. For some crops, Minnesota summers are not long enough to allow them to reach maturity.

Cool-Season and Warm-Season Crops

Cool-season crops are able to tolerate colder temperatures and can be planted earlier than warm-season crops. Examples of cool-season vegetables are lettuce, cabbage, cauliflower, broccoli, Brussels sprouts, and onions. Warm-season crops, including tomatoes, eggplant, and peppers, should not be planted outside until after frost danger in mid-to-late May. Some plants can be started indoors or in a greenhouse and later transplanted outdoors.

Starting Plants

Plants can be grown in two ways: direct seeding and transplanting. Direct seeding is when seeds are planted in their final destinations. This method works well for faster-growing flowers and vegetables. Slower-growing flowers and vegetables do better when they are started indoors and later transplanted or moved to their final destinations. Many gardens use both methods of planting. Read seed packets and refer to the chart on pages 54-56 to determine the best method for the plants you have selected.



USDA Plant Hardiness Zone Map - Minnesota

Source <http://planthardiness.ars.usda.gov/PHZMWeb/#>

The United States Department of Agriculture (USDA) has developed a map to assist gardeners when selecting plants. The map reflects the average extreme minimum temperature by zone using data from 1976-2012. Gardeners use zone information to select plants that thrive in their climate. This is especially important for perennial plants that over-winter.

Planting Dates and Distances for Garden Vegetables

Vegetable	Planting Dates		Planting Distances (in inches)			
	Start seed indoors	Plant seed or plant outdoors	Between rows, hand cultivated	Between plants	Depth of seeding (inches)	Amount to order per 20 feet of row
Asparagus		April 15 - May 1 (crowns)	36	12 - 18	6 - 8	15 crowns
Beans, snap (bush)		May 15 - July 1	18 - 24	3 - 4	1½ - 2	3 - 4 oz.
Beans, snap (pole)		May 15 - July 1	36	4 - 6	1½ - 2	2 - 3 oz.
Beans, dry shell		May 15	18 - 24	3 - 4	1½	3 - 4 oz.
Beans, lima		May 15 - June 10	18 - 24	4 - 6	1½	3 - 4 oz.
Beets		April 15 - July 1	12 - 18	2 - 4	½ - 1	1 packet
Broccoli	March 1 - 15	April 15 or June 1	24 - 30	24	¼ (indoors)	1 packet or 9 plants
Brussels sprouts	March 1 - 15	April 15 or June 1	24 - 30	24	¼ (indoors)	1 packet or 9 plants
Cabbage, early	March 1 - 15	April 1 - May 1	24 - 30	18	¼ (indoors)	1 packet or 12 plants
Cabbage, late	April 15 - May 1	June 1	24 - 30	24	¼ (seedbed)	1 packet or 9 plants
Cabbage, Chinese		July 1	24 - 30	18	½	1 packet
Carrots		April 15 - June 15	18 - 24	2 - 3	¼	1 packet
Cauliflower	March 1 - 15	April 15 or June 1	24 - 30	18 - 24	¼ (indoors)	1 packet or 12 plants
Celery	Feb. 15 - March 1	May 15	18 - 24	8	1/8 (indoors)	1 packet or 24 plants
Chard, Swiss		May 1	18 - 24	6 - 8	1	1 packet
Collards		April 15	24 - 36	6	¼	1 packet

"Packet" refers to average commercially-packaged seed packet.

Vegetable	Planting Dates		Planting Distances (in inches)			
	Start seed indoors	Plant seed or plant outdoors	Between rows, hand cultivated	Between plants	Depth of seeding (inches)	Amount to order per 20 feet of row
Cucumbers		May 1 - June 15	48 - 60	12 between single plants; 36 between hills of three	1	1 packet
Eggplant	March 15 - April 1	June 1	24 - 30	24	¼ (indoors)	1 packet or 9 plants
Endive		April 15	18 - 24	8 - 12	½	1 packet
Garlic		Oct. 1 - Nov. 1	18 - 24	4 - 6	3 - 4	1 lb. of cloves
Horseradish		April 15 - May 1	24 - 30	12 - 18	6 (roots)	18 roots
Kale		April 15 - July 15	18 - 24	12 - 18	½	1 packet
Kohlrabi		April 15 - June 1 or Aug. 1 - 15	18 - 24	6	½	1 packet
Lettuce, leaf		April 15 - June 1 or Aug. 1 - 15	12 - 18	4 - 6	¼	1 packet
Lettuce, head	March 1 - 15	April 15 - May 1	18 - 24	12	¼ (indoors)	1 packet or 18 plants
Muskmelon		May 15 - June 1	60 - 72	18	1	1 packet
Okra	March 15 - April 1	June 1	24 - 36	12 - 15	½ (indoors)	1 packet
Onion seeds		April 15	12 - 24	2	½	1 packet
Onion, transplants	Feb. 1 - 15	April 15	12 - 24	2 - 3	½ (indoors)	1 packet
Onion, sets		April 15	12 - 24	2 - 3	1 - 2	½ lb.
Parsley		April 15 - May 1	12 - 24	4 - 6	¼	1 packet
Parsnips		May 1 - 15	18 - 24	3 - 4	½	1 packet
Peas		April 10 - May 15	18 - 24	2	1½	1 packet
Pepper	March 15 - April 1	June 1	24 - 36	18 - 24	½ (indoors)	1 packet or 12 plants
Potatoes, Irish		April 15 - June 1	24 - 30	12 - 18	4 (each piece)	3 lbs. seed potatoes
Potatoes, sweet	April 15 (roots)	June 1	36 - 48	18 - 24		9 - 12 plants
"Packet" refers to average commercially-packaged seed packet.						

Vegetable	Planting Dates		Planting Distances (in inches)			
	Start seed indoors	Plant seed or plant outdoors	Between rows, hand cultivated	Between plants	Depth of seeding (inches)	Amount to order per 20 feet of row
Pumpkin		May 10 - June 1	72 - 96	24 - 36 between single plants; 60 - 72 between hills of three	1 - 2	1 packet
Radish		April 10 - June 1 or Aug. 1 - 15	6 - 12	1 - 2	½	1 packet
Rhubarb		April 15 - May 1	36 - 48	36 - 48		5 or 6 plants
Rutabaga		May 15 - June 15	18 - 24	8 - 12	½	1 packet
Spinach		April 15 or Aug. 1 - 15	12 - 18	3 - 4	½	1 packet
Squash, summer		May 10 - June 1	24 - 36	24 - 36	1	1 packet
Squash, winter		May 10 - June 1	72 - 96	24 - 36 between single plants; 60 - 72 between hills of three	1	1 packet
Sweet corn		May 10 - July 1	30	12	1 - 2	1 packet
Tomato	April 1 - 15	May 15 - June 1	24 - 36	36 - 48	¼ (indoors)	1 packet or 6 - 8 plants
Turnip		April 15 or Aug. 1	15 - 18	3 - 4	½	1 packet
Watermelon		May 15 - June 1	60 - 72	24 - 36 between single plants; 60 - 72 between hills of three	½	1 packet
"Packet" refers to average commercially-packaged seed packet.						

Source: <http://www.extension.umn.edu/distribution/horticulture/dg1422.html>

Information on growing flowers in Minnesota can be found on the University of Minnesota Extension website at <http://www1.extension.umn.edu/garden/yard-garden/flowers/>.

Types of Gardens

Gardens come in many shapes and sizes. The goals of your garden and resources available help you determine what type of garden is best for your school.

Container Gardens

Smaller garden projects work well in containers. Criteria for an effective container include ability to hold soil, holes in the bottom for drainage, and enough room for root growth. Suggested containers include pots, plastic totes, bushel baskets, and wooden barrels. If you are planting edible crops, be sure toxic materials have not contaminated the container. Larger containers need less frequent watering and fertilizing. Select a good potting soil to fill containers. Garden soil is often too heavy and becomes compact when used in a container.



Raised Beds

In a raised bed garden, soil is raised above its surroundings. The bed is contained within a structure between six inches and waist high. Raised beds are most often constructed of wood but can be made of rock or concrete block. Raised beds for children are typically no more than three feet wide, allowing students to reach the middle. Advantages of raised beds include clearly defined garden space, loose soil that is better for root growth, ability to warm quickly in spring, and well-drained soil. In addition, plants are less likely to be stepped on by students. Raised beds are also more handicap accessible.



In-Ground Beds

Before preparing a site for an in-ground bed, dig several samples of soil and have it tested. Testing is available from the University of Minnesota's Soil Testing Laboratory, visit their website for more information <http://soiltest.cfans.umn.edu/>. If soil tests are acceptable, the next step is tilling. Tilling introduces air into the soil, making it easier to plant and easier for plants to grow. Soil that is too wet or too dry should not be tilled. To determine if soil has the proper amount of moisture, form a handful of soil into a ball. If the moisture is correct, the ball will hold its shape but easily fall apart when touched. Compost and fertilizer may be added to soil during the tilling process. Newly started gardens need more than one tilling before planting. In-ground beds require the removal of grass.

Hydroponics

Hydroponics is a method of growing plants with nutrient-rich water instead of soil. A growing medium such as rock wool or clay pellets is used to anchor the roots. Systems can be set up in a classroom with grow lights, allowing students to have a gardening experience in the winter. Other advantages of hydroponics include a controlled pest environment, easier harvest, and ability to recycle water. Schools interested in using a hydroponic system are advised to find a hydroponic grower in the area who can provide assistance and troubleshooting.

Grade

Middle School

Materials/Preparation

- ☐ Teacher Material A – Challenges with Growing Plants – one per teacher and one overhead transparency
- ☐ Teacher Material B – Plant Doctor – Challenges with Growing Plants – one per teacher
- ☐ Handout A – Plant Doctor Field Guide – one per student
- ☐ Assessment A – Plant Doctor – Challenges with Growing Plants – one per student
- ☐ Writing surface
- ☐ Writing instruments
- ☐ Various healthy and unhealthy plants

Plant Doctor – Challenges with Growing Plants

Minnesota K-12 Academic Standards

Science	5.1.1.2	Scientific inquiry requires identification of assumptions, use of critical and logical thinking, and consideration of alternative explanations.
Science	7.1.1.2	Scientific inquiry uses multiple interrelated processes to investigate questions and propose explanations about the natural world.
Math	5.2.1	Recognize and represent patterns of change; use patterns, tables, graphs and rules to solve real world and mathematical problems.

Summary/Overview

Students take a look at the challenges of raising plants. They learn the five major challenges of growing plants and do their best to solve plant problem puzzles.

Garden Connection

Students learn how to investigate challenges faced by plants.

Background Information

Growing plants is a huge part of our planet! Plants across the globe feed, clothe, medicate, and shade us. Growing plants can be very challenging. Five major challenges face anyone who grows plants. Those challenges are insects, nutrients, weeds, disease, and weather.

Objectives

- Identify challenges related to growing plants.
- Evaluate five plant scenarios and explain which major challenge(s) caused the damage.

Fun Fact

The tomato is by definition a fruit because it contains the plant's seeds, although its lack of sweetness puts it in the vegetable category for most eaters.



Procedure

Interest Approach

Display a number of different plants. One plant would be sufficient, but it's ideal if you have access to a variety of plants, including a food-producing plant, an ornamental plant, a healthy plant, and a plant that is struggling. Point out that some of the plants are doing really well, and others are not. (Adapt according to your examples.) Ask students for some hypotheses about how well or poorly these plants are doing. Ask students if they feel like they have a green thumb. Whether students have a green thumb or not, raising plants can be a tough task. There are challenges associated with growing plants whether planting a garden for home or school, or planting crops to feed the world. During this lesson, students learn the five major challenges of growing plants and work to solve a few puzzling plant problems.

Summary of Content and Teaching Strategies

Help students break into groups. A random grouping could be accomplished by handing out different plant seeds (one type for each group formed). Students find students with the same seed to form the groups. Show and review the Teacher Material A.

Give groups up to 10 minutes to review and discuss the Plant Doctor Field Guide on Handout A. Keep students on task and answer any questions. Give students time benchmarks at five minutes, two minutes and one minute remaining.

Now that students are "experts," put their skills to work in thinking critically and being problem solvers. Read or show a scenario (Teacher Material B). Groups work to figure out exactly what happened that led to the plant problem. Allow groups to take turns asking yes or no questions that lead to the root of the problem. All groups hear each question and answer as they try to figure out the problem in the given scenario. Students cannot ask if it is a weed, insect, weather, disease, or nutrient issue. Take student questions and provide answers. To solve the mystery, a whole group must stand and explain their answer. If they are not correct, they are out of the round and cannot answer again.

Teacher Material B Plant Doctor Scenario Answers

Scenario 1:

A section of the cornfield is infected by insects, the European Corn Borer. The insects just recently started infecting the field, and they began in this small spot. A storm came through the night before, but it was only strong winds. The combination of the wind and the insect damage caused the corn to lay over.

Scenario 2:

During the time when the potatoes were to bloom and form, a hailstorm knocked the blossoms off the potato plants. The farmer knew the plants had been hit, but when they bounced back and continued to grow, he thought they were fine. Unfortunately, without the blooms, the potatoes didn't develop.

Scenario 3:

The teacher used soil from her home garden for all the plants. This soil was low in potassium, which caused the plants to develop a purple tint. The potassium deficiency led to diseases when the plants did not receive sufficient water. White and yellow stripes formed on the leaves. The plants didn't do well with the changing temperature in the room.

Scenario 4:

The problem is a fungus or disease that kills and thins out the grass. The fungus is most active when it is warm and very humid. Conditions are perfect this year. The fungus grows really fast when grass is highly fertilized with nitrogen.

Challenge Scenario:

This family lived in the country. When they dug up a piece of ground, seeds from a weed called Johnson Grass were able to grow. The weeds look a lot like corn and the family never cut them down. During pollination, the Johnson Grass cross-pollinated with the corn, which caused the corn to not produce ears of sweet corn. Their friends in the city didn't have to deal with Johnson Grass.

NOTE TO INSTRUCTORS: This activity is really designed to cause dissonance as students strive to figure out the issues. Feel free to give hints or alter the information given to help students find the answers. Your job is to only answer yes or no. The point is for students to continue to look for clues to find the root of the cause. The scenarios match what they read in their Plant Doctor Field Guide. After they solve the scenario, explain any details the students may have missed or expand on the scenario information if you desire.

Review/Summary

Have students take a second look at the plants on display. What do they now see or think after learning about the challenges of growing plants? Do they have ideas of why these plants look the way they do? Discuss all the options of the challenges the plants face as a review of the content.

Modifications/Extensions

Schedule a trip with students to a nearby nursery, agricultural field, or golf course and have someone discuss and show the challenges they face working with plants. You could also work with your school's groundskeepers to take the students on a tour of the campus. The purpose is to discuss what precautions the school takes to maintain healthy plants on school grounds.

Set up a mathematical problem for the students related to insect or pest damage to crops. For example, a farmer owns a 100-acre sweet corn field that will yield a net profit of \$300 an acre. Unfortunately, the field has insect damage and only 75 to 90 percent of the field will be profitable. Have students create a table that records the total net profit of the field for any harvest between 75 and 90 percent.



Sources/Credits

Adapted from: National FFA Organization *Middle School Food and Agricultural Literacy Curriculum*, sponsored by the National Pork Board as a special project of the National FFA Foundation. Visit www.ffa.org/documents/learn/MS.PS.5.3.pdf to access the full-length version of this lesson.

Plant Doctor - Challenges with Growing Plants

Five major challenges face anyone who grows plants:

Insects: Some insects can damage or even destroy crops.

Nutrients: Plants need certain nutrients to stay healthy and productive.

Weeds: These are plants that compete against the plants you want to grow.

Diseases: Pesky bacteria, viruses, fungi, and other things that kill your crop.

Weather: Abnormal weather is a big factor in growing crops.

Plant Doctor – Challenges with Growing Plants

Scenario 1

A farmer drives out to his or her field of corn and finds a small section of six-foot-tall corn lying on the ground. What happened, plant doctors?

Scenario 2

A local organic farmer plants a large section of potatoes this year. The potato plants seem to grow as expected but when he begins to dig up the potatoes to harvest them, he doesn't find any potatoes. What could have happened?

Scenario 3

A teacher at your school decides she is tired of her room looking so boring. She decides to grow her own plants so the class can watch them grow and also to make her room more appealing. She plants a few flowers, an ivy vine that grows up the window, and a small spider plant that hangs from the ceiling near the window. The plants do well at first, but later they wilt and have some funny colored spots on them. Why is her green thumb not so green?

Scenario 4

The Garden Club has a golf tournament every year. This year is especially hot, it has rained a lot, and it is very humid outside. As the teams line up to get started, you are in the cart going to the first hole. You hit a beautiful shot up onto the green, and as you walk to putt it in, you notice large discolored round areas on the green. This could really mess up your winning putt! What in the world is going on?

Challenge Scenario

A family gets really excited to grow corn in their back yard this year. They work a piece of soil, plant the corn, and work very hard every day to make sure it has all it needs to grow. There are some weeds on the outskirts of the garden, but they aren't taking water or sun from the corn. Their friends, who live in the city, are already harvesting beautiful ears of corn, but their corn plants aren't producing beautiful ears of sweet corn. What happened?



Plant Doctor Field Guide

Tips for Identifying Insect Damage

- Plants will often show obvious damage from insects eating the leaves or fruit.
- Insects sometimes damage parts of plants that you can't see, like the stems or the roots.
- Damage to the stems and roots slow down the growth but also affect the plant's structure.
- When insects move from plant to plant, they can spread diseases.

Tips for Identifying Disease Damage

- Plants may appear wilted or have colored spots on the leaves, stems, or fruit.
- You will often find a white powdery substance on the leaves.
- Certain viral and bacterial diseases discolor the entire plant.
- Plants with diseases are usually smaller and don't grow as well.
- Moisture in the soil and the temperature sometimes cause diseases to form under the ground on roots or underground fruit.
- Insects can transfer diseases.

Tips for Identifying Nutrient Damage

- Plants' main nutrient needs are nitrogen, phosphorous, and potassium.
- Nitrogen is key for plant growth and development. It helps the plant make chlorophyll, which produces a pretty green plant. A lack of nitrogen makes the plant yellow and stunted.
- Phosphorous is important for producing seeds. It also helps develop strong roots. A lack of phosphorous causes the plant to have a purple color.
- Potassium is important in helping a plant resist diseases and changing weather conditions. Without enough potassium, plants appear to have burned tips and may have yellow or white streaks on the leaves.

Tips for Identifying Weed Damage

- Weeds compete for the resources that are important for plants to grow. They use water, shade the plants from sun, use valuable nutrients, and spread disease.
- Some weeds can cross-pollinate with a crop, causing plants to not produce fruit.
- Weeds multiply quickly by spreading their seeds.

Tips for Identifying Weather Damage:

- Too much water can cause plants to have too little air in the soil. Not enough water causes plants to wilt.
- Storms with high winds, hail, floods, or cold temperatures can affect the plant's ability to produce fruit or grow properly.
- Storms can affect the pollination of plants by damaging the flower.
- Cold weather and freezing during the growing season kills many plants.
- Some weather conditions can promote disease.
- Storms can make it difficult for people to tend to their crops.

Name _____



Plant Doctor - Challenges with Growing Plants

1. List the five major challenges of growing plants.

2. If a plant is small and looks yellowish, it probably has _____.

- a. been attacked by insects.
- b. been over-watered.
- c. a nitrogen deficiency.
- d. a phosphorous deficiency.

3. If you see a white powdery substance on a plant, it most likely _____.

- a. has been infected by the European Corn Borer.
- b. has some type of disease.
- c. has been covered in pollen from a weed.
- d. none of the above.

4. How can weather affect the growing of plants?

- a. Too much rain can cause plants to not get enough air in the roots.
- b. Hail can disrupt plant pollination.
- c. Cold temperatures during the growing season can damage plants.
- d. All of the above.

5. Insects can damage plants by eating plant tissue, but they also can _____.

- a. spread plant diseases to other plants.
- b. use water that the plant needs.
- c. cause a nutrient deficiency by eating the nutrients.
- d. attract birds that eat the plants.